



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

[Handwritten signature]

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/735,167	12/12/2003	Frank Cardone	YOR919970121US2 (16323A)	1673
23389	7590	08/25/2005		EXAMINER
SCULLY SCOTT MURPHY & PRESSER, PC 400 GARDEN CITY PLAZA SUITE 300 GARDEN CITY, NY 11530			DUONG, KHANH B	
			ART UNIT	PAPER NUMBER
			2822	

DATE MAILED: 08/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/735,167	CARDONE ET AL.	
	Examiner Khanh B. Duong	Art Unit 2822	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 27 July 2005.
- 2a) This action is **FINAL**. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-6 and 18-28 is/are pending in the application.
- 4a) Of the above claim(s) 18-21 is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-6 and 22-28 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ . |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>12/12/03</u> . | 6) <input type="checkbox"/> Other: _____ . |

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Group I, Claims 1-6 and 22-28 in the reply filed on July 27, 2005 is acknowledged.

Claims 18-21 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim.

Priority

This application is a DIVISIONAL of application No. 08/885,611 filed June 30, 1997, now U.S. Patent No. 6,723,621.

Specification

The disclosure is objected to because of the following informalities: page 1, line 12, "phosphorus" is incorrect should be --phosphorous--.

Appropriate correction is required.

*** Applicant is hereby suggested to review the entire specification and make appropriate corrections for the same error.

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

The following title is suggested: A SEMICONDUCTOR STRUCTURE HAVING AN ABRUPT DOPING PROFILE.

Claim Objections

Claims 1, 6, 22, 25 and 27 are objected to because of the following informalities:

Re claim 1, line 6, claim 22, line 6, claim 25, line 4, and claim 27, lines 11 and 15, “phosphorus” is incorrect should be --phosphorous--.

Re claim 4, lines 1-2, “a concentration change” is unclear and should be --a concentration change of said dopant--.

Re claim 6, line 2, after “doping of”, “P” should be --phosphorous--.

Re claim 22, line 3, after “charge”, “is” should be replaced with --in--.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-6 and 22-28 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Re claim 1, line 4, claim 22, line 5, claim 25, line 3, and claim 27, line 10, “the critical thickness” is unclear in scope and meaning as to which layer the critical thickness is associated with. Furthermore, it lacks antecedent basis in each of the claims.

Other claims are rejected as depending on the rejected base claim(s).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1-6 and 22-26 are rejected, as best understood, under 35 U.S.C. 103(a) as being unpatentable over Murakami et al. (U.S. Patent No. 5,241,197) in view of Meyerson (U.S. Patent No. 5,316,958).

Re claims 1-6, Murakami et al. ("Murakami") discloses in FIG. 2A a structure having an abrupt doping profile comprising: a single crystal semiconductor substrate 1 having an upper surface, a first epitaxial layer 2 of Ge over said upper surface, said first epitaxial layer 2 having a thickness (20 nm or less) less than "the critical thickness", said first epitaxial layer 2 having a concentration of dopant of about 1×10^{19} atoms/cc, and a second epitaxial layer 32 of a semiconductor material (SiGe) over said first epitaxial layer 2, wherein said second epitaxial layer 32 having a concentration of dopant of about 5×10^{17} to 5×10^{18} atoms/cc [see col. 3, line 40 to col. 4, line 16]. Murakami discloses, in FIG. 5 (Embodiment-2), a third epitaxial layer 57 of semiconductor material (SiGe) having a doping profile with a dopant concentration of about 1×10^{18} atoms/cc [see col. 4, line 62 to col. 5, line 19]. In addition, Murakami discloses, in FIG. 9A (Embodiment-6), said second epitaxial layer 32 having a thickness of 300 angstroms [see col. 7, lines 15-22].

Re claims 22-24, Murakami further discloses in FIG. 9B a field effect transistor comprising: a single crystal substrate 1 having source and drain regions 50 with a channel therebetween and a gate electrode 4 above said channel to control charge in said channel and a first layer 2 of Ge having a thickness (20 nm) less than "the critical thickness" doped with a dopant (Sb) positioned below said channel and extending through said source and drain regions 50, wherein said channel is in a second epitaxial layer 32 of SiGe formed over said first layer 2.

Art Unit: 2822

Re claims 25 and 26, Murakami further discloses in FIG. 5 a field effect transistor comprising: a single crystal substrate 1, a first layer 2 of Ge less than “the critical thickness” doped with a dopant; a second layer 55 of undoped SiGe epitaxially formed on said first layer 2, a third layer 57 of strained undoped semiconductor material selected from the group consisting of SiGe, a source region 5 and a drain region 6 with a channel therebetween, and a gate electrode 4 above said channel to control charge in said channel.

Re further claims 1, 3, 4 and 6, Murakami fails to disclose the following: said first epitaxial layer 2 having a thickness in the range from 0.5 to 2 nm and a concentration of dopant greater than 5×10^{19} atoms/cc, said dopant selected from the group consisting of phosphorous and arsenic [Claims 1 and 3]; said second layer having a concentration change of said dopant greater than 1×10^{19} atoms/cc from said first layer into 40 angstroms of said second layer, or said second epitaxial layer 32 having a doping of P less than 5×10^{16} atoms/cc for a predetermined thickness after its initial 300 angstroms thickness [Claims 4 and 6].

Re further claims 22, 23, 25 and 26, Murakami fails to disclose the following: said dopant selected from the group consisting of phosphorous and arsenic [Claims 22 and 25], and said first epitaxial layer 2 of Ge is in the range from 0.5 to 2 nm thick [Claims 23 and 26].

Myerson suggests using phosphorous or arsenic as alternative dopant material for making n-type regions in epitaxial layer, wherein the concentration of dopant being about 1×10^{14} to about 1×10^{20} atoms/cc [see col. 5, lines 8-20]. Myerson further states “[t]he doping level is determined based on the desired device characteristics”.

Since Murakami and Myerson are from the same field of endeavor, the purpose disclosed by Myerson would have been recognized in the pertinent prior art of Murakami.

Therefore, because these dopant materials and their concentrations were art-recognized equivalents as suggested by Myerson, one of ordinary skill in the art would have found it obvious to use either phosphorous or arsenic based on a desired concentration to form n-type regions in the epitaxial layers of Murakami.

Furthermore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to optimize and select an appropriate dopant concentration greater than 5×10^{19} atoms/cc. The selection of parameters such as energy, power, concentration, temperature, time, depth, thickness, etc., would have been obvious and involve routine optimization which has been held to be within the level of ordinary skill in the art. "Normally, it is to be expected that a change in temperature, or in concentration, or in both, would be an unpatentable modification. Under some circumstances, however, changes such as these may be impart patentability to a process if the particular ranges claimed produce new and unexpected result which is different in kind and not merely degree from results of prior art ... such ranges are termed 'critical ranges' and the applicant has the burden of proving such criticality ... More particularly, where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In re Aller*, 105 USPQ 233, 235 (CCPA 1955). See also MPEP 2144.05.

Allowable Subject Matter

Claims 27 and 28 would be allowable if rewritten or amended to overcome the objection and rejection under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action.

The following is a statement of reasons for the indication of allowable subject matter: none of the prior art of record, taken alone or in combination, fairly shows or suggests all the limitations as claimed.

Re claim 27, none of the prior art of record discloses the following limitations, in combination with other limitations: a first layer of Ge less than the critical thickness doped with a dopant selected from the group consisting of phosphorus and arsenic selectively positioned over exposed portions of said source and drain regions, a second layer of semiconductor material selected from the group consisting of Si and SiGe doped with a dopant selected from the group consisting of phosphorus and arsenic epitaxially formed over said first layer to form raised source and drain regions.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following U.S. Patents disclose relevant teachings regarding transistors having epitaxial Ge layers: Moslehi '105, Legoues '187 and Yamazaki '152.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khanh B. Duong whose telephone number is (571) 272-1836. The examiner can normally be reached on 10:00-6:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

KBD



AMIR ZARABIAN
SUPERVISOR PATENT EXAMINER
TECHNOLOGY CENTER 2800